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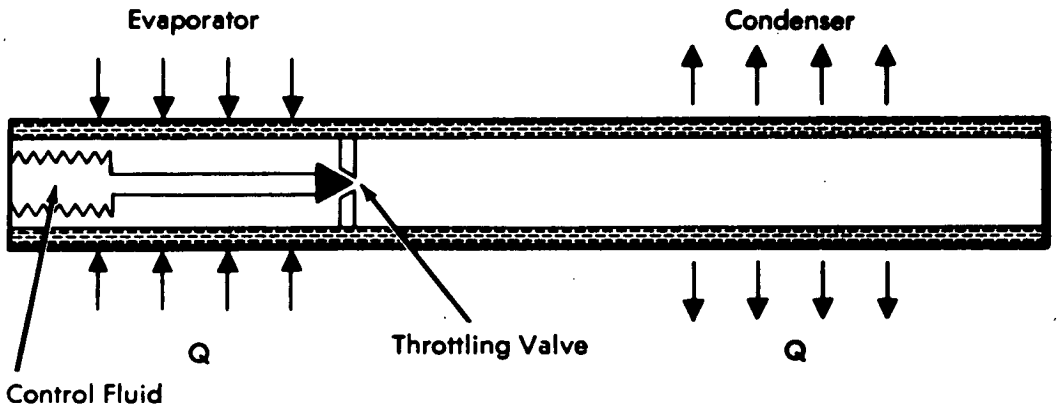
Throttleable Heat Pipe



The problem:

To modify a heat pipe so that the rate at which it draws heat from a source can be varied.

The solution:

Provide variable thermal conductance by throttling or interrupting vapor flow between the evaporator and condenser sections of the heat pipe.

How it's done:

As illustrated in the diagram, passively-controlled throttling can be accomplished by means of a valve which is operated by the movement of an extensible container (bladders or bellows) filled with a liquid that has a high coefficient of thermal expansion. The bellows expands when the evaporator temperature exceeds the control point and opens the valve poppet; thus, the valve orifice is enlarged and the rate of heat transfer is increased. Similarly, the bellows contracts when the evaporator temperature recedes from the control point, thereby decreasing the rate of heat transfer.

A potential advantage of the throttling technique over other methods of control is that no bulky gas reservoirs are required. Additionally, the entire condenser is maintained at a nearly uniform temperature so that there is a better thermal interface with surrounding equipment.

The most important advantage is the close control offered under conditions in which the sink temperature varies and is not far below the evaporator temperature. High, variable sink temperature conditions seriously limit the control capabilities of passive gas-controlled heat pipes because of vapor pressure variations within the reservoir and gas-blocked condenser sections. The throttleable or vapor-modulation scheme does not suffer any equivalent limit for high sink temperature. In fact, performance improves as the sink temperature approaches the evaporator temperature in that smaller evaporator-to-condenser pressure differentials are required.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
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Reference: B74-10173

(continued overleaf)

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Patent status:

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